

**Testimony of**  
**Dr. Rod Heitschmidt**  
**Research Leader**  
**Fort Keogh Livestock & Range Research Laboratory**  
**Agricultural Research Service**  
**U.S. Department of Agriculture**  
**Miles City, Montana**  
  
**for the**  
  
**U.S. House of Representatives**  
**Committee on Agriculture**  
**Subcommittee on Conservation, Credit, Rural Development, and Research**  
  
**Congressional Field Hearing**  
**Miles City, Montana**  
**August 12, 2005**

Mr. Chairman, and members of the Subcommittee, I thank you on behalf of the entire Fort Keogh staff for this opportunity to provide a brief overview of the rich history of Fort Keogh, past research accomplishments, and current research goals and objectives. As you have probably already discovered, Fort Keogh is very proud of its research accomplishments, past, present and projected, and we thank you for honoring us with this opportunity.

Early History

The Cantonment at Tongue River, the precursor to Fort Keogh, was established near the mouth of the Tongue River on August 28, 1876. The name Fort Keogh first appeared on the Post Return in October 1877. The War Department officially designated the name of Fort Keogh on November 8, 1878.

Fort Keogh was named after Captain Myles Walter Keogh. Miles City was named after Colonel Nelson Appleton Miles, the first Commander of Fort Keogh.

Colonel Miles chose a site about 1 mile west of the original cantonment for the permanent Fort Keogh. Construction of the Fort began in 1877 in concert with the “June rise” of the Yellowstone River thereby facilitating the arrival of about 500 people and associated building materials via steamboats. By the end of 1877, Fort Keogh had been turned into one of the largest Army posts in the U.S. with more than 25 buildings. Fort Keogh was considered the most “livable” Post of the West.

Fort Keogh continued as an Army Post until October 27, 1908. In 1909, Fort Keogh was resurrected as a Remount Station raising horses for the U.S. cavalry. In 1916 at the height of

World War I, Fort Keogh's horse inventory was 1,773 horses. It is rumored that 100,000 horses were processed through Fort Keogh during its Remount days but I am unaware of any published data supporting this claim. But there is little doubt that Fort Keogh was an important Remount Station during the period from 1909 to 1924 at which time the Remount Station was closed and the Fort was turned over to the United States Department of Agriculture.

For a more detailed history of Fort Keogh as a military post, we recommend reading the California State University M.A. thesis of Josef James Warhank entitled "Fort Keogh: Cutting Edge of a Culture." A copy of the thesis can be found on the Fort Keogh web site (<http://www.ars.usda.gov/npa/ftkeogh>).

### Historical Research Endeavors and Accomplishments

The focus of the earliest research at Fort Keogh was on animal genetics and rangeland ecology and management with animal reproduction and nutrition playing key contributing roles. Evidence of the key role animal genetics research has played at Fort Keogh is gleaned from the fact that since 1924, we have conducted fundamental genetic research on sheep; milking shorthorns; Belgian, Morgan, and Thoroughbred horses; turkeys; swine; and beef cattle. Today, however, our on-station genetics animals are limited to 2 beef cattle herds as the milking shorthorn herd was dispersed in the late 1930's, turkeys in 1939, sheep in 1941, horses in 1964, and swine in 1986. Significant program accomplishments in animal genetics include:

- Identifying the effects of inbreeding in turkeys on fertility, egg production, egg weight, and egg hatchability;
- Providing original crosses of turkeys that led to the development of the Beltsville White breed, the first meat-type turkey developed in the U.S.;
- Developing the Morgan x Thoroughbred cross as the "ultimate cow horse" for the 1920's and 1930's;
- Developing the Montana No. 1 breed of hogs;
- Developing Line 1 Hereford cattle, the oldest and probably purest line of Herefords in the entire world having been line bred at Fort Keogh since 1934. Today, the Line 1 selection project is the longest-running beef cattle selection program in the world. The importance of these animals to beef cattle genetics research is clearly reflected by the selection of a Line 1 female, L1 Dominette 01449, for the sequencing of the beef cattle genome by USDA-ARS and several cooperating Universities. In addition, it has been estimated that more than 70 percent of all purebred Herefords have some Line 1 breeding in their pedigree;
- Pioneering concept and protocols for genetic evaluation of beef cattle wherein selection standards were changed from visual appraisals to quantified performance standards. This single accomplishment had and continues to have tremendous impact on beef cattle seed stock breeding programs as evidenced by today's breeding standards;
- Computing first heritability estimates for performance traits of beef cattle;
- Quantifying the relative effects of heredity vs. environment on beef cattle performance;
- Establishing some of the earliest cross-breeding programs in the U.S. leading to today's standard cross-breeding programs;

- Participating in the USDA-ARS Germplasm Evaluation program through the use of Fort Keogh Angus, Red Poll, Pinzgauer, and Simmental sires;
- Developing a stable composite gene combination (CGC) herd of beef cattle consisting of a cross of ½ Red Angus, ¼ Tarentaise, and ¼ Charolais;
- Quantifying impacts of an array of selection criterion on beef cattle performance including selection for yearling weight (Line 1), birth weight (Line 1 & CGC), and the ratio between cow weights and calf weaning weights (CGC);
- Identifying functional alleles controlling double muscling in beef cattle; and
- Pioneering selection indices that optimize economic profits.

Although reproductive performance has always been an important aspect of the Fort Keogh research program, our reproductive physiology program did not officially begin until 1960. Significant accomplishments in the reproductive physiology program include:

- Pioneering development of equine semen collection and AI technologies;
- Developing methods to control brucellosis under rangeland grazing conditions;
- Identifying key post-weaning nutritional regimens for expediting heifer puberty;
- Discovering that although zeranol implants (i.e., Ralgro) increase rates of gain, they also reduce heifer pregnancy rates and bull testicle size and semen production;
- Showing that replacement heifer pregnancy rates increase dramatically if heifers are cycling prior to the beginning of the breeding season;
- Learning that heifer puberty is a function of an array of factors other than solely a function of body composition;
- Showing that calf birth weight is the primary factor affecting dystocia (i.e., delayed and difficult birthing);
- Learning that cows given obstetrical assistance in a timely manner display increased fertility the following year;
- Developing protocols for improving postpartum reproduction success such as early weaning and feeding of supplements that improve cow nutritional status;
- Showing that a minimum condition score of 5 at calving is an excellent means of improving postpartum conception rates;
- Developing effective beef cattle breeding synchronization protocols using a combination of progestogen and prostaglandin;
- Identifying synchronization of estrus and gonadotropin superovulation treatments as effective management treatments for increasing twinning in beef cattle; and
- Discovering, in cooperation with personnel at Iowa State University and the University of Iowa, the mode of action (i.e., reduced blood flow to placenta) of the compound (i.e., isocupressic acid) in Ponderosa pine needles whereby cows calve prematurely when consuming Ponderosa pine needles in the last trimester of pregnancy.

Fundamental treatments in most beef cattle production studies are nutritional because of the profound impact of nutrition on animal growth and reproduction. Thus, nutrition research has always been a cornerstone of the Fort Keogh animal research program. For example, many studies were initiated in the early years to determine the value of various, locally produced feedstuffs (e.g., alfalfa hay, corn silage, wheatgrass hay, barley, and wheat mill screenings) on

cattle, sheep, swine, horses, and turkey performance. Still, a formal rangeland animal nutrition program was only begun in 1971. Significant nutrition research accomplishments include:

- Pioneering studies showing grazing time, forage intake, and forage digestibility decline in concert with declining air temperatures;
- Finding that most winter, free-ranging beef cattle nutritional short-comings in Northern Great Plains rangelands are related to protein rather than energy constraints. Results are the product of a series of multi-year studies designed to quantify the seasonal dynamics in crude protein content and digestibility of rangeland forages;
- Discovering that the effects of protein supplementation during winter on beef cow performance is tied closely to quantity and quality of forage available which in turn is largely the product of previous year's forage production and current year's amount of snow cover;
- Finding that time of day when animals are fed supplement affects forage intake as steers fed energy supplement in morning (7:30 a.m.) eat less and diets are lower in digestible energy intake than steers fed in early afternoon (1:30 p.m.);
- Learning that early weaned calves (84 days) can be raised on commonly available feedstuffs and that performance dramatically exceeds that of suckling calves;
- Developing state-of-the-art technologies for frequent measuring of animal weights, water intake, diet quality, forage intake, and rates of passage of free-ranging grazing beef cattle;
- Quantifying the positive effect of cows grazing perennial, cool-season dominated seeded pastures in early spring as compared to grazing of native rangeland;
- Discovering that steers with high growth potential gain faster on finishing diets than lower growth potential steers resulting in greater meat production and carcass weights of leaner grade at comparable levels of efficiency. However, carcass size when steers reached choice grade were above that required to maximize economic returns;
- Quantifying positive impacts of 2X intensive early season stocking of stocker steers on production per acre;
- Identifying mineral nutritional short-comings in rangeland forages; and
- Quantifying the economic merits of a late spring (June) calving season as compared to late winter (February) and early spring (April) calving seasons.

Range management research was initiated at Fort Keogh in 1932 under the direction of the U.S. Forest Service. Since that time, there have been a number of major accomplishments including:

- Defining appropriate "safe" or "fully sustainable" stocking rates for this region. These 35-year stocking rate studies were the first long-term stocking rate studies conducted in the U.S.;
- These long-term studies (i.e. 1935 – 1970) also provided critical information as to the varied impacts of drought on Northern Great Plains rangelands. Research documented the decline of important species during drought and their subsequent recovery;
- Studies also documented the detrimental effects of drought on cow-calf production and the interaction effects of varying stocking rates on production whereby declines in production are magnified as rates of stocking are increased;

- Quantifying the relative merits of a wide array of seeded forages in beef cattle grazing systems. Two seeded species identified as particularly adapted to this region are crested wheatgrass and Russian wildrye both of which repeatedly provide an abundance of high quality spring forage over a series of years (i.e., persistence) when properly managed;
- Discovering fall planting of most seeded species enhances stand established over spring planting;
- Quantifying the effects of a wide array of range improvement practices on rangeland forage and livestock production. Practices evaluated included soil tillage and furrowing, water spreading, fertilization, burning, and herbicide applications. In every evaluation, results showed that the merits of each practice was tied closely to the situation at hand and selection of the “best management practice” was linked to managers’ understanding of the ecological effects of the selected practice;
- Documenting that the major factor affecting the productivity and condition of Northern Great Plains rangelands is climatic conditions rather than management factors. Information has played a major role in the development of sustainable beef cattle production systems as successful managers fully recognize these said constraints and in turn, adopt highly flexible management strategies;
- Defining the capacity of Northern Great Plains rangelands to sustain themselves as perennial, cool-season grasslands as opposed to shifting to a dominance of annual grasses. Results show that plant species composition of Northern Great Plains rangelands is relatively stable with minimal shift toward a dominance of annual grasses similar to the Great Basin region of North America;
- Developing detailed understandings of the ecological role Japanese brome plays in the Great Plains. Japanese brome is the dominant, non-indigenous, invading annual grass in the Great Plains. These detailed understandings greatly enhance land managers’ ability to affect rates and extent of invasion on an annual basis and thereby limit long-term detrimental impacts on ecological condition and livestock production;
- Providing visual documentation, via repeat photography of Northern Great Plains rangelands over an 80-year period, that ecological condition has not declined but rather remained constant, or in most instances, dramatically improved; and
- Developing a simple, easy-to-use, effective drought management decision support system that dramatically reduces grazer’s ecological and economical risks.

For a more detailed explanation of historical research findings, we recommend reviewing our “Historical Perspectives” articles published in our 1993 Field Day Report, a copy of which can be found on our web site (<http://www.ars.usda.gov/npa/ftkeogh>).

### Current Resources

Originally, the Fort consisted of 90 to 100 sections of land extending approximately 10 miles south and west of the confluence of the Tongue and Yellowstone Rivers. Today the Fort consists of about 85 sections of land giving way to the development of the community of Miles City. Boundaries today extend about 6.5 miles directly west of the confluence of the Tongue and Yellowstone Rivers, which is about 2 miles west of where the mouth of the Tongue River was

located in 1876, then 10 miles directly south, about 11 miles back east to the Tongue River, then north east along the Tongue River, our east boundary, to the Yellowstone River.

Currently, Fort Keogh consists of about 50,000 acres of native rangeland, 3,000 acres of seeded dryland pasture, 1,000 acres of seeded irrigated pasture, 800 acres of irrigated cropland (i.e., corn silage, alfalfa and barley hay, and sudan sorghum), 1260 acres of Yellowstone River with 400 acres of river islands, and 1350 acres of corrals, headquarters area, I-94, etc. We have about 220 miles of roads and vehicle trails and 400 miles of fence.

Our current animal breeding female inventory consists of 215 Registered Line 1, 514 CGC, 463 reproductive physiology, 274 nutrition, and 65 “other” (Total = 1,531). We have 86 breeding bulls and 1,061 calves. We have a total of 24 horses at Fort Keogh of which about ½ are owed by workers and the other ½ by Fort Keogh.

The full-time USDA-ARS staff consists of 10 scientists, 11 technicians, and 7 administrative. The temporary staff of 5–10 employees is employed at various times during each year. ARS funding of the laboratory for FY05 is \$3.1 million.

Fort Keogh is run in cooperation with the Montana Agriculture Experiment Station (MAES). The full-time MAES staff at Fort Keogh consists of 18 ranch/farm workers, 2 professionals and 1 administrative assistant. A temporary staff of 4-6 workers is present at various times during the year. Funds to support this staff are generated through a Specific Cooperative Agreement between ARS and Montana State University (MSU) and by the sale of livestock. This is possible because all the livestock at Fort Keogh belong to MAES. No State of Montana funds are appropriated for the operation of Fort Keogh.

In addition, 2 full-time MSU Extension Service personnel have offices at Fort Keogh. Fort Keogh provides administrative support for both the Eastern Regional Department Head and the Beef Cattle Specialist.

Fort Keogh has a full array of farm and ranch facilities and the needed equipment required to meet research needs. We have a modern laboratory/office complex that doubled in size in 2004 when two additions were added onto the building, a 39,000 bushel automated feedmill, 2 feedlots with a total capacity of about 1000 head, plus 43 “out” buildings including barns, sheds, shops, storage garages, etc. We have 3 buildings listed on the National Register of Historic Places. These are the recently restored water wagon house built in 1883, the first ARS office building built originally in 1920 to serve as a mess hall for the Remount Depot and now used as a carpenter shop and storage area, and the horse barn built in 1934 to facilitate equine research and now used as the working headquarters for our cowboy crews.

### Current Research Program

The mission of the Fort Keogh Livestock and Range Research Laboratory is to research and develop ecologically and economically sustainable rangeland based livestock production systems. Our research program is centered on the 2 fundamental components of rangeland based, livestock production systems, that being the rangeland resource and the grazing animals.

The focus of our rangeland research program is to develop sustainable management schemes that reduce both ecological and economic risks. This project is a component of ARS' National Program on Rangeland, Pasture and Forages. It is entitled "Low Risk Management Strategies for Sustaining Range Beef Cattle Production Systems." The project is supported by 5 scientists.

Program justification centers on the idea that rangeland agriculture (i.e., grazing) is a high risk venture subject to considerable ecological and economic risks. Its sustainability is linked, therefore, to grazers' ability to manage these high levels of uncertainty over both time and space. The research is designed to reduce levels of risk by: 1) improving our understanding of both the short- and long-term ecological consequences of climatic conditions, particularly drought, and various grazing tactics; 2) developing proactive, early warning drought management strategies; 3) screening newly developed forage germplasm for persistence, potential productivity, and quality as they relate to grazing animals' performance and productivity; 4) developing improved methods for assessing forage quality; 5) determining the mechanisms responsible for differing levels of beef cattle production as a function of differing seasons of calving; 6) identifying the economic merits of varying seasons of calving and subsequent post-weaning management strategies, and 7) identifying innovative livestock management strategies that impede the ingress of noxious weeds in Northern Great Plains rangeland ecosystems. In addition, a portion of this research is designed to quantify the capacity of Northern Great Plains rangelands to sequester and store atmospheric carbon. Such information is vital for the development of sound, national, climate-change-related, land management policies particularly in light of the vast amounts of rangelands located in the Northern Great Plains region as well as across the United States.

Examples of recent accomplishments include:

- The successful development of a simple, user-friendly, drought management decision support system,
- The identification of "best management" post-fire grazing tactics to enhance the ecological health of the range resource and concurrently reduce economic losses sustained from wildfires,
- Finding that rates of carbon sequestration in these grasslands are generally low and they are affected more by climatic conditions than grazing tactics, and
- Determining that late spring (June) calving can increase profits over spring calving by reducing input costs.

The focus of our animal research program is to develop a productive, ecologically superior beef cow. This project is a component of ARS' National Program for Food Animal Production. It is entitled "Developing Beef Cattle Better Suited for Sustainable Production." The project is supported by 4 scientists.

The central theme of this program is to lay a foundation for accelerating genetic improvement toward more efficient, profitable and sustainable beef production by reducing input costs arising from use of harvested feeds. It is predicated on the assumption that cost of external energy needed to produce harvested feeds will increase causing a concurrent increase in costs of traditional production systems. Successful reproduction is the single largest determinant of

biological and economical efficiencies of cow-calf production and no production system is sustainable without it. Many commonly measured phenotypes indicative of reproductive success by beef females have low heritability and are measured relatively late in life compared to growth and carcass characteristics. Acceleration of genetic improvement requires selection criteria of higher heritability that can be measured earlier in life than those presently available. Thus, our goals are to: 1) better understand indicators of reproductive success and failure, 2) determine quantitative and molecular relationships between traits measured early in life and lifetime reproductive performance, 3) evaluate opportunities to identify animals that are reproductively efficient with less reliance on harvested feeds, and 4) develop tools to aid producers in making selection decisions. Our approaches integrate basic physiological mechanisms controlling reproduction with quantitative and molecular genetics characterization. Bringing this research to fruition will contribute to 1) understanding mechanisms controlling reproductive success and failure under nutritionally stressful conditions and 2) knowledge needed by beef producers to make informed selection decisions that improve production efficiency, profitability, and sustainability in the future.

Examples of recent accomplishments include:

- The development of sire selection indices that optimize profit from future progeny,
- The identification of size of an ovulatory follicle as a key indicator of cow reproductive capacity,
- The discovery of key quantitative trait loci that affect growth, carcass characteristics, and palatability of beef, and
- Providing key resources for the international bovine genome sequencing project.

For a detailed explanation of on-going research projects supporting the above 2 research programs, please review our 2005 Research Update found on our web site (<http://www.ars.usda.gov/npa/ftkeogh>).

This concludes my testimony, Mr. Chairman, and I will be happy to answer any questions you or the other members of the Subcommittee may have at this time.

**ROD HEITSCHMIDT**

*Range Ecologist and Research Leader*

*USDA - Agricultural Research Service*

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**PROFESSIONAL AND ACADEMIC APPOINTMENTS**

1967-1968 - Graduate Research Assistant, Fort Hays State University, Kansas

1968-1969 - Graduate Research Assistant, University of Texas

1969-1974 - Pilot, USAF

1974-1977 - Graduate Research Assistant, Colorado State University

1977-1981 - Assistant Professor, Texas Agricultural Experiment Station

1982-1986 - Associate Professor, Texas Agricultural Experiment Station

1987-1990 - Professor, Texas Agricultural Experiment Station, Vernon

1990-present - Research Leader and Superintendent, Fort Keogh Livestock and Range Research Laboratory, USDA - Agricultural Research Service,

**EDUCATION**

B.S. (Botany), Fort Hays State University, Kansas, 1967

M.S. (Botany), Fort Hays State University, Kansas, 1968

Aeronautical Rating, USAF, Columbus AFB, Mississippi, 1970

Ph.D. (Range Science), Colorado State University, 1977

**PROFESSIONAL MEMBERSHIPS AND ACTIVITIES**

International Society for Range Management

Outstanding Achievement Award (1991)

Associate Editor, Journal Range Management (1987-1991)

Director, Texas Section (1988-1990)

President, Northern Great Plains Section (1997)

Director, Society for Range Management (1996 -1999)

1st Vice-President, Society for Range Management (2001)

President, Society of Range Management (2002)

Fellow Award (2004)

American Institute of Biological Sciences

Ecological Society of America

Phi Kappa Phi

Beta Beta Beta

Council for Agricultural Science and Technology

Director (1997-2000)

The Nature Conservancy

Soil and Water Conservation Society

**PROFESSIONAL INTERESTS AND ACTIVITIES****Research:**

General interest is systems ecology. Specific interests center on drought management and plant/animal interactions, grazing management and community ecology of grassland ecosystems as they relate to quantity and quality of forage produced, quantity and quality

of forage consumed and livestock production. Also, has a keen interest in sustainable agriculture issues.

### Senior and Junior Authored Publications

Refereed Journals - 70+  
Book Chapters and Proceedings - 50+  
Technical Reports & Popular Articles - 115+  
Invited Presentations - 135+  
Abstracts - 85+

### Refereed Science Publications since 2000

- Haferkamp, M.R., and **Heitschmidt, R.K.** Japanese brome impacts on northern Great Plains rangelands. *Great Plains Res.* 9:315-327. 2000.
- Grings, E.E., **Heitschmidt, R.K.**, Short, R.E., and Haferkamp, M.R. Intensive early stocking for yearling cattle in the Northern Great Plains. *J. Range Manage.* 55:135-138. 2001.
- Hild, A.L., Karl, M.G., Haferkamp, M.R., and **Heitschmidt, R.K.** Drought and Grazing III: Root dynamics and seedling emergence. *J. Range Manage.* 54:292-298. 2001.
- Haferkamp, M.R., Grings, E.E., **Heitschmidt, R.K.**, MacNeil, M.D., and Karl, M.G. Suppression of annual bromes impacts rangelands: Animal responses. *J. Range Manage.* 54:663-668. 2001.
- Haferkamp, M.R., **Heitschmidt, R.K.**, Grings, E.E., MacNeil, M.D., and Karl, M.G. Suppression of annual bromes impacts rangelands: Vegetation responses. *J. Range Manage.* 54:656-662. 2001.
- Grings, E.E., Short, R.E., Haferkamp, M.R., and **Heitschmidt, R.K.** Animal age and sex effects on diets of grazing cattle. *J. Range Manage.* 54:77-81. 2001.
- Heitschmidt, R.K.**, Johnson, J., and Klement, K.D. Science, social values and livestock grazing in the Great Plains. *Great Plains Res.* 11:361-374. 2001.
- Haferkamp, M.R., Grings, E.E., **Heitschmidt, R.K.**, and MacNeil, M.D. Quality and persistence of cool-season forages in the Northern Great Plains. *J. Range Manage.* 55:482-487. 2002.
- Eneboe, E.J., Sowell, B.F., **Heitschmidt, R.K.**, Karl, M.G., and Haferkamp, M.R. Drought and grazing: IV. Effects on blue grama and western wheatgrass tiller dynamics. *J. Range Manage.* 55:197-203. 2002.
- Emmerich, W.E. and **Heitschmidt, R.K.** Drought and grazing: II. Effects on water yield and quality. *J. Range Manage.* 55:229-234. 2002.
- Grings, E.E., **Heitschmidt, R.K.**, Short, R.E., and Haferkamp, M.R. Intensive-early stocking for yearling cattle in the Northern Great Plains. *J. Range Manage.* 55:135-138. 2002.
- Heitschmidt, R. K.**, Grings, E.E., and Vermeire, L.T. Is rangeland agriculture sustainable? *J. Anim. Sci. (E. Suppl.):* E138 – 146. 2004.
- Grings, E.E., Short, R.E., Haferkamp, M.R., and **Heitschmidt, R.K.** Late summer protein supplementation for yearling cattle in the Northern Great Plains. *J. Range Manage.* 55:358-364. 2004.
- Vermeire, L.T., **Heitschmidt, R.K.**, Johnson, P.S., and Sowell, B.F. The prairie dog story: Do we have it right? *Bioscience* 54:689–695. 2004.
- Heitschmidt, R.K.**, Klement, K.D., and Haferkamp, M.R. Interaction effects of drought and grazing on Northern Great Plains rangelands. *J. Range. Ecol. Manage.* 58:11-19. 2005.

- Allen, V., **Heitschmidt, R.K.**, and Sollenberger, L. Grazing systems and strategies. In: C. Jerry Nelson (ed.). Forages, Vol. II. Iowa State Univ. Press, Ames, Iowa. 2004. (Book Chapter)
- Heitschmidt, R. K.** and Vermeire, L.T. An ecological and economic risk avoidance drought management decision support system. p. 178. In: Pastoral systems in marginal environments, Proc. of Satellite Workshop, XX International Grassland Congress. 2005 (Proceedings).

### **Selected Invited Presentations since 1995**

- "Sustainable agriculture and ecosystem management" 4th Prairie Conservation and Endangered Species Workshop, Lethbridge, Alberta, Canada, February 1995.
- "Grazing management: Technology for sustaining rangeland ecosystems," for special issue of Australian Rangeland Journal, the Official Journal of the Australian Rangeland Society. Fall 1995.
- "Grazing management and sustainability" at International Symposium on Animal Production Under Grazing, Animal Science Department of the Federal University of Vicosa, Vicosa, Minas Gerais, Brazil, November 1997.
- "Ecology, agriculture, and sustainability," at a 5 day, 6 meeting series of Saskatchewan Agriculture and Food extension programs, January 1998.
- "Cows, ecology, and sustainability" at annual meeting of the International Beef Improvement Federation. Calgary, Alberta, Canada, July 1998.
- "Sustainability of grazing in the Great Plains of North America" at the 6<sup>th</sup> International Rangeland Congress, Sustaining Rangeland Enterprises Session, Townsville, Queensland, Australia, July 1999.
- "Ecosystems, sustainability, animal agriculture, and bison," at the International Bison Conference. Edmonton, Alberta, Canada, July 2000.
- "Is rangeland agriculture sustainable?" at the annual meeting of the American Society of Animal Science, Phoenix, AZ. June 2003.
- "Do you have to run out of forage before managing?" at the Satellite Workshop, XX International Grasslands, Glasgow, Scotland, July 2005.

### **Selected Professional Advisory/Consultation Activities since 1995**

- Member of Issues Management Team, Montana Beef Council. 1991-present.
- Member of CSRS National Research Initiative Agricultural Systems review committee, Washington D.C., August 1996.
- Member of Select Panel, USDI National Park Service charged with developing ecosystem management strategies for Rocky Mountain National Park. Estes Park, CO. April 1997.
- Member of Stewardship Award Committee, National Cattlemen's Beef Association. 1998 - 2001.
- Acting Associate Area Director, USDA-ARS Northern Plains Area, Fort Collins, CO. January 1 - February 28, 1997.
- Acting National Program Leader for Rangeland, Pasture and Forages, Washington D.C. November 1, 1999 - January 5, 2000.
- Member, Board of Directors, Society for Range Management, 1996-1999, 2000-2002
- Member, Board of Directors, Council on Agricultural Science and Technology (CAST), 1998-2000
- President, Society for Range Management. 2002.

Member of Planning Committee, 20<sup>th</sup> International Grassland Congress Satellite Workshop, Belgrade, Ireland, 2003–2005.  
Served on select, 8-member USDA Forest Service National Grassland's Science Review Team. 2003–2005.  
Served as expert advisor to Agren Inc., Des Moines, IA, in developing “best practices” rangeland insurance program for Risk Management Agency. Nebraska City, NE (August 2003), Omaha, NE (December 2003).

#### **MS & PhD Graduate Student Committees**

Texas A&M University  
Co-chair - 3  
Member - 7  
Montana State University  
Co-chair - 1  
Member - 2  
External Reviewer  
University of Natal - 3  
University of Alberta - 1

#### **ADDITIONAL PROFESSIONAL AWARDS/RECOGNITION**

Outstanding Instructor Pilot, Laughlin Air Force Base, 1972.  
Employer of the Year, Miles City Area Chamber of Commerce. 1994.  
Alumni Achievement Award, Fort Hays State University, Hays, KS. “The Alumni Achievement Award honors graduates for significant accomplishments in business or professional life, or for distinguished humanitarian service to their community, state or nation.” 1997. (Less than 0.5% of graduates receive honor).  
Received Federal Laboratories Consortium Outstanding Laboratory Award For Technology Transfer, Mid-Content Region, 2002.  
Selected To Receive Friend Of Extension Award, Montana State University Extension Honorary Association, 2005.